PATENT ABSTRACTS OF JAPAN

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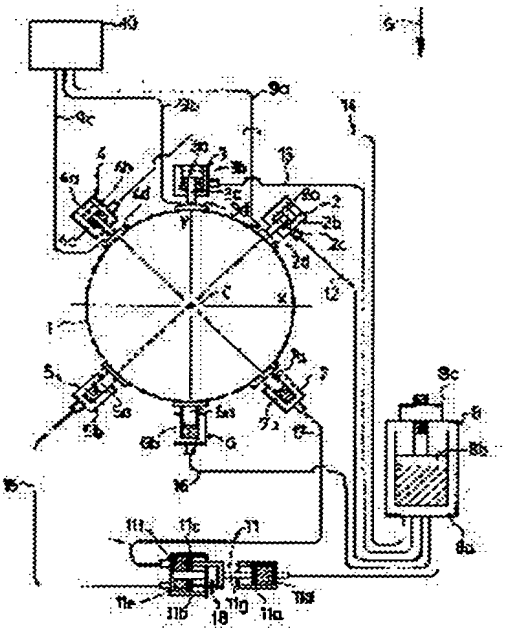
(54) OPTICAL MEMBER HOLDING DEVICE

(57)Abstract:
PURPOSE: To eliminate need for adjusting holding power and to easily exchange a mirror.
CONSTITUTION: Since the acting characteristics of the pistons of hydraulic jacks 2–4 on the upper side of the vertical mirror 1 and the pistons of hydraulic jacks 5–7 on the lower side thereof are reverse, the pistons 2a–4a of the jacks 2–4 on the upper side are elevated when the pistons 5a–7a of the jacks 5–7 on the lower side are lowered. Besides, the diameters of the respective pistons 2a–7a are set to be a prescribed value according to a holding point and the holding power of the respective jacks 2–7 is equally distributed by the weight of the mirror 1. Then, the mirror 1 can be held under a state that distorsion is suppressed to be the minimum.



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CLAIMS

[Claim(s)]

[Claim 1] At least four jacks equipped with the supporter material which is arranged every predetermined spacing along with the circumferencial direction of the disc-like vertical mold optical member of a water Hiramitsu shaft, and supports the side face of said vertical mold optical member, and the attachment component which holds this supporter material movable, It has the pressure source which supplies the fluid of this pressure to the space between said supporter material and said attachment components. Two jacks with which said supporter material operates to an opposite direction mutually to the core of said optical member among said four jacks according to the pressure buildup of said space and which support said vertical mold optical member upside, Opposite arrangement of the two jacks which support said vertical mold optical member bottom is carried out, respectively. It sets up so that allocation of the force in which said each supporter material does the path of the supporter material of said four jacks and an attachment component to said vertical mold optical member may turn into predetermined allocation. The optical member supporting structure characterized by establishing the direction of X fixed means which makes the same the amount of projections of said supporter material of two jacks which arrange a connection means to connect said vertical mold optical member with the supporter material of two jacks of said vertical mold optical member upside, and support said vertical mold optical member bottom or upside.

[Claim 2] The optical member supporting structure according to claim 1 characterized by preparing the direction adjustment device of Y which adjusts the amount of said fluid supplied from said pressure source.

[Claim 3] At least four jacks equipped with the supporter material which is arranged every regular intervals along with the circumferencial direction of the disc-like horizontal-type optical member of a vertical optical axis, and supports the underside of said horizontal-type optical member, and the attachment component which holds this supporter material movable, It has the pressure source which supplies the fluid of this pressure to the space between said supporter material and said attachment components. In the middle of piping which connects two jacks located on one [which intersects perpendicularly on the underside of said horizontal-type optical member among said four jacks] biaxial shaft, and said pressure source The 1st tilt fixed means which makes

the same the amount of projections of said supporter material of both jacks is established. The optical member supporting structure characterized by establishing the 2nd tilt fixed means which makes the same the amount of projections of said supporter material of both jacks in the middle of piping which connects two jacks located on the shaft of another side, and said pressure source.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention relates to the optical member supporting structure suitable as the supporting structure of the mirror of the projection optical system of the semi-conductor aligner which imprints a detailed pattern on a wafer about the optical member supporting structure.

[0002]

[Description of the Prior Art] The conventional optical member supporting structure is constituted by the adjustment implement holding the disc-like vertical mold mirror of a water Hiramitsu shaft in which two or more telescopic motion is possible, and each adjustment implement is arranged in the side face of a vertical mold mirror every predetermined spacing.

[0003] Drawing 6 is drawing showing ideal allocation of the holding power of the supporting structure of a vertical mold mirror. The drawing Nakaya mark G shows the gravity direction. It is the force on a Y-axis F0 When it carries out and the include angle from a Y-axis is set to theta, it is holding power F. F=F0 COStheta It becomes (1) type.

[0004] Drawing 6 expresses the ideal weight distribution of (1) type with vectors 62-67.

[0005] In order to make it this allocation conventionally, each adjustment implement was made to expand and contract, and the vertical mold mirror 1 was pushed, or lengthened and adjusted.

[0006]

[Problem(s) to be Solved by the Invention] However, since the dimension and weight of a vertical mold mirror changed at every exchange when a vertical mold mirror was exchanged for another vertical mold mirror, adjustment of the holding power in each retaining point needed to be redone, and exchange of a vertical mold mirror was complicated. Moreover, also when a vertical mold mirror was exchanged for the vertical mold mirror of the same mold, since the dimension and weight of a vertical mold mirror

changed delicately, they had the need for readjustment.

[0007] Furthermore, in inside, the optical member supporting structure might have to be remade only by a dimension changing.

[0008] This invention was made in view of such a situation, that technical problem has unnecessary holding power adjustment, and exchange of a mirror is offering the easy optical member supporting structure.

[0009]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem the optical member supporting structure of invention according to claim 1 At least four jacks equipped with the supporter material which is arranged every predetermined spacing along with the circumferencial direction of the disc-like vertical mold optical member of a water Hiramitsu shaft, and supports the side face of said vertical mold optical member, and the attachment component which holds this supporter material movable, It has the pressure source which supplies the fluid of this pressure to the space between said supporter material and said attachment components. Two jacks with which said supporter material operates to an opposite direction mutually to the core of said optical member among said four jacks according to the pressure buildup of said space and which support said vertical mold optical member upside, Opposite arrangement of the two jacks which support said vertical mold optical member bottom is carried out, respectively. It sets up so that allocation of the force in which said each supporter material does the path of the supporter material of said four jacks and an attachment component to said vertical mold optical member may turn into predetermined allocation. A connection means to connect said vertical mold optical member with the supporter material of two jacks of said vertical mold optical member upside was arranged, and the direction of X fixed means which makes the same the amount of projections of said supporter material of two jacks which support said vertical mold optical member bottom or upside was established.

[0010] Moreover, the optical member supporting structure of invention according to claim 2 prepared the direction adjustment device of Y which adjusts the amount of said fluid supplied from said pressure source.

[0011] Furthermore, the optical member supporting structure of invention according to claim 3 At least four jacks equipped with the supporter material which is arranged every regular intervals along with the circumferencial direction of the disc-like horizontal-type optical member of a vertical optical axis, and supports the underside of said horizontal-type optical member, and the attachment component which holds this supporter material movable, It has the pressure source which supplies the fluid of this

pressure to the space between said supporter material and said attachment components. In the middle of piping which connects two jacks located on one [which intersects perpendicularly on the underside of said horizontal-type optical member among said four jacks] biaxial shaft, and said pressure source The 1st tilt fixed means which makes the same the amount of projections of said supporter material of both jacks was established, and the 2nd tilt fixed means which makes the same the amount of projections of said supporter material of both jacks was established in the middle of piping which connects two jacks located on the shaft of another side, and said pressure source.

[0012]

[Function] With the jack of an optical member upside, and a lower jack, since the operating characteristic of a piston is reverse, if the piston of a lower jack falls, the piston riser of an upper jack and the path of each piston will be set as a predetermined value according to a retaining point, respectively, and the holding power of each jack will be uniformly distributed by the weight of an optical member.

[0013] Moreover, the underside of a horizontal-type optical member is supported with at least four jacks. The 1st tilt fixed means which makes the same the amount of piston projections of those jacks in the middle of piping which connects two jacks located on one [which intersects perpendicularly on the underside of a horizontal-type optical member among four jacks] biaxial shaft, and pressure sources is established. If the 2nd tilt fixed means which makes the same the amount of piston projections of those jacks in the middle of piping which connects two jacks located on the shaft of another side and pressure sources is established The holding power of a jack is uniformly distributed by the weight of a horizontal-type optical member, and the tilt of a horizontal-type optical member is also kept level.

[0014]

[Example] The example of this invention is explained based on a drawing below.

[0015] The whole block diagram and drawing 2 which show the optical member supporting structure which drawing 1 requires for the 1st example of this invention are the side elevation of the optical member supporting structure of drawing 1 . The side face of the disc-like vertical mold mirror 1 of a water Hiramitsu shaft is supported with six hydraulic jacks 2-7, and hydraulic jacks 2-7 are arranged every predetermined spacing along with the circumferencial direction of the vertical mold mirror 1. Hydraulic jacks 2-7 are attached using the universal joint which is not illustrated on the frame which is not illustrated so that the force may not be applied other than radial.

[0016] Hydraulic jacks 2-7 consist of pistons 2a-7a and cylinder 2b · 7b. The drawing

Nakaya mark G shows the gravity direction, and the adhesive disks 2d-4d for adsorbing the side face of the vertical mold mirror 1 are formed at the head of the piston narrow diameter portions 2c-4c which constitute a part of pistons 2a-4a of the hydraulic jacks 2-4 arranged at the vertical mold mirror 1 upside. Adhesive disks 2d-4d are connected to vacuum devices 10 through Piping 9a-9c. If vacuum devices 10 operate, adhesive disks 2d-4d will stick to the side face of the vertical mold mirror 1, and hydraulic jacks 2-4 and the vertical mold optical mirror 1 will be connected.

[0017] Hydraulic jacks 2-7 are connected to the reserve tank 8 through piping 12-17. A reserve tank 8 supplies the oil of this pressure to cylinder 2b of hydraulic jacks 2-7 - 7b.

[0018] The path of said pistons 2a-7a is set as the predetermined value, respectively. In the hydraulic jacks 2-4 arranged at the vertical mold mirror 1 upside, the path (in the case of this upside, the area of the part which receives a pressure except the area of a piston narrow diameter portion is meant.) of piston 3a is larger than the path of Pistons 2a and 4a, and the path of Pistons 2a and 4a has it. [mutually equal] In the hydraulic jacks 5-7 arranged at the vertical mold mirror 1 bottom, the path of piston 6a is larger than the path of Pistons 5a and 7a, and the path of Pistons 5a and 7a is mutually equal.

[0019] Moreover, in order to balance the force of the hydraulic jack of an upside and the bottom, the path of Pistons 3a and 6a is equal, and its path of 2a, 4a, 5a, and 7a is also equal.

[0020] By setting up the path of Pistons 2a-7a as mentioned above, the pressure is changed so that the holding power in each retaining point may become ideal allocation (allocation to which distortion of the vertical mold mirror 1 becomes min) of the aforementioned (1) formula. Holding power becomes maximum on the Y-axis (vertical axis) of the vertical mold mirror 1 by radial, and becomes zero on the X-axis. The property which decreases is set to 0-90 degrees of COS. The hydraulic jacks 2-4 arranged at the vertical mold mirror 1 upside act so that the vertical mold mirror 1 may be pulled up, and the hydraulic jacks 5-7 arranged at the vertical mold mirror 1 bottom act so that the vertical mold mirror 1 may be pushed up. Magnitude is the same although the direction of the force of the upper hydraulic jacks 2-4 and the direction of the force of the lower hydraulic jacks 5-7 are reverse. With the upper hydraulic jacks 2-4 and the lower hydraulic jacks 5-7, since the activity direction of a piston is reverse, if the pistons 5a-7a of the lower hydraulic jacks 5-7 fall, the pistons 2a-4a of the upper hydraulic jacks 2-4 will go up by this example. By having cylinder 8a, piston 8b, and device 8c that adjusts a piston location, and adjusting a piston location, the total oil quantity in piping 12-17 can change said reserve tank 8, and it can adjust the direction of Y when doubling a mirror core centering on [C] equipment (core of the polygon which

connected each retaining point and was able to do it).

[0021] Among piping 12-17, piping 15 and 17 turns into piping of one on the way, and the piston assembly 11 as a direction of X fixed means is arranged in the branch point. The piston assembly 11 consists of cylinder 11a, cylinders 11b and 11c, pistons 11d, 11e, and 11f, and rod 11g. Cylinder 11a is connected to the reserve tank 8. Cylinder 11b is connected to a hydraulic jack 5, and cylinder 11c is connected to the hydraulic jack 7.

[0022] It holds in cylinder 11a piston 11d, and piston 11e is held in cylinder 11b, and it holds in cylinder 11c piston 11f, respectively. It is formed in two forks, and connects with Pistons 11e and 11f, piston 11d is connected with rod 11g one side, rod 11g one side is interlocked with piston 11d, and Pistons 11e and 11f slide on it. Moreover, in order to adjust the difference of the amount of projections of piston 5a of a hydraulic jack 5, and the amount of projections of piston 7a of a hydraulic jack 7, the controller material 18 which adjusts the location of piston 11e is attached in rod 11g.

[0023] Moreover, since a Pistons [11e and 11f] diameter is equal and the sum of a both pistons [11e and 11f] projected net area and a piston 11d projected net area are equal, the pressure of I/O of the piston assembly 11 does not change.

[0024] Next, actuation of the optical member supporting structure of this example is explained.

[0025] If vacuum devices 10 operate, the adhesive disks 2d-4d of the hydraulic jacks 2-4 arranged at the vertical mold mirror 1 upside will stick to the side face of the vertical mold mirror 1, and hydraulic jacks 2-4 and the vertical mold mirror 1 will be connected. Suppose that slight path clearance exists between the pistons 5a-7a of hydraulic jacks 5-7 and the side faces of the vertical mold mirror 1 which have been arranged at the vertical mold mirror 1 bottom at this time.

[0026] Connection of hydraulic jacks 2-4 and the vertical mold mirror 1 drops gradually the pistons 2a-4a of hydraulic jacks 2-4 in response to the gravity of the vertical mold mirror 1. Descent of Pistons 2a-4a supplies oil to the hydraulic jacks 5-7 arranged through discharge and a reserve tank 8 at the vertical mold mirror 1 bottom from cylinder 2b-4b. If oil is supplied, the oil pressure in cylinder 5b - 7b of hydraulic jacks 5-7 will become high, Pistons 5a-7a will go up (ejection), and the side face of the vertical mold mirror 1 will be contacted. Thus, when the path clearance of Pistons 5a-7a and the vertical mold mirror 1 becomes zero, hydraulic jacks 2-7 will share the weight of the vertical mold mirror 1, and when a load balances, the direction location of Y of the vertical mold mirror 1 becomes settled. The sum of the direction component of a force of Y of each pistons 2a-7a at this time becomes the weight of the vertical mold mirror 1.

[0027] Moreover, when Pistons 2a-4a descend and oil is supplied to a reserve tank 8, it

flows in cylinder 11a of the piston assembly 11, and piston 11d moves leftward [of drawing 1], piston 11d is interlocked with and, as for a part of oil, Pistons 11e and 11f move only the same amount of strokes in this direction. Since it is equal to the path of the pistons 5a and 7a of hydraulic jacks 5 and 7 as mentioned above, when the oil of this ** is supplied to Cylinders 5b and 7b from the piston assembly 11, the amount of strokes of Pistons 5a and 7a (the amount of projections) becomes the same. Consequently, the direction location of X of the vertical mold mirror 1 is restrained.

[0028] Since the holding power of hydraulic jacks 5-7 is uniformly distributed by the weight of the vertical mold mirror 1, when exchanging the vertical mold mirror 1 for other vertical mold mirrors from which a dimension and weight differ according to the optical member supporting structure of this example, it is not necessary to redo adjustment of the holding power in each retaining point, and exchange of a vertical mold mirror becomes easy.

[0029] In addition, although the optical member supporting structure of this example is a system using gravity, since hydraulic lines 12-17 are also influenced of gravity, it is necessary to amend the water head difference of oil pressure. However, it may not pass over the error by the water head difference to about 1% (rate to the one half of the weight of the vertical mold mirror of the difference of the holding power of a vertical mold mirror upside and the bottom when it is the vertical mold mirror of 50mm in the radius of 150mm, and thickness, and specific gravity 3 and the water head difference of the optical member supporting structure is the specific gravity 1 of 500mm and oil), but it may omit amendment. What is necessary is just to judge with mirror precision whether it omits or not. As the amendment approach, modification of the diameter of a piston, the activity of a regulator, etc. can be considered.

[0030] Moreover, in this example, although the vertical mold mirror was held six points using six hydraulic jacks 2-7, it may be made to use six or more hydraulic jacks [even] 2-7, and holding power is distributed, so that a number increases, and effect which it has on the vertical mold mirror 1 can be made small.

[0031] Furthermore, although this example described the case where oil was used as incompressible fluid, it replaces with this and you may make it use compressible fluid, such as air, depending on mirror precision.

[0032] In addition, although this example described the case where the piston assembly 11 was arranged in the middle of the piping 15 and 17 of the hydraulic jacks 5 and 7 arranged at the vertical mold mirror 1 bottom, it replaces with this and you may make it arrange in the middle of the hydraulic lines 12 and 14 of the hydraulic jacks 2 and 4 of the vertical mold mirror 1 upside.

[0033] Moreover, pressure meter and a regulator are added to the actuation section of each hydraulic jacks 2-7 of this example, and you may make it raise an adjustment function.

[0034] Furthermore, although this example described the case where the path of Pistons 2a-7a was set as a predetermined value, respectively, it replaces with this, and if a regulator (pressure regulator) is used, the diameter of a piston can be made the same.

[0035] In addition, although the adhesive disks 2d-4d as a connection means were made to stick to the side face of the vertical mold mirror 1, it replaces with this, and the head of the piston narrow diameter portions 2c-4c of hydraulic jacks 2-4 is pasted up on the side face of the vertical mold mirror 1, or a boss with a hole or a slot is prepared in the side face of the vertical mold mirror 1, and you may make it make it connect with the member by the side of a frame in this example.

[0036] Moreover, although considered as the configuration which uses six hydraulic jacks in this example, four except the jacks 3 and 6 arranged in the direction of Y of drawing 1 are available also as a configuration holding a mirror 1.

[0037] The whole optical member supporting structure block diagram which drawing 3 requires for the 2nd example of this invention, and drawing 4 are the side elevations of the optical member supporting structure of drawing 3 .

[0038] Although the above-mentioned example described the optical member supporting structure which holds six side faces of the vertical mold mirror 1 using six hydraulic jacks 2-7, this example describes the supporting structure of the disc-like horizontal-type mirror of a vertical optical axis.

[0039] In this example, eight hydraulic jacks 22-29 are used, and each hydraulic jacks 22-29 are arranged every fixed spacing along with the circumferencial direction of the horizontal-type mirror 21. Each hydraulic jacks 22-29 are supporting the underside of the horizontal-type mirror 21. Moreover, hydraulic jacks 22-29 are connected to the reserve tank 48 through piping 32-39.

[0040] Biaxial P1 which intersects perpendicularly on the underside of the horizontal-type mirror 21, and P2 One shaft P1 As 1st tilt fixed means which makes the same the amount of piston projections of each jacks 22 and 26 in the middle of the piping 32 and 36 which connects two hydraulic jacks 22 and 26 located upwards and reserve tanks 48 The ** piston assembly 41 is formed and it is the shaft P2 of another side. The piston assembly 51 as 2nd tilt fixed means which makes the same the amount of piston projections of each jacks 24 and 28 in the middle of the piping 34 and 38 which connects two hydraulic jacks 24 and 28 located upwards and reserve tanks 48 was formed. The structure of the piston assemblies 41 and 51 is the same as the piston

assembly 11 of drawing 1 , and omits explanation. The tilt of the horizontal-type mirror 21 is restrained by the piston assemblies 41 and 51.

[0041] According to the optical member supporting structure of this example, since the holding power of hydraulic jacks 22-29 is uniformly distributed by the weight of the horizontal-type mirror 21, when exchanging the horizontal-type mirror 21 for other horizontal-type mirrors, it is not necessary to redo adjustment of the holding power in each retaining point, and exchange of the horizontal-type mirror 21 becomes easy.

[0042] Drawing 5 is the whole optical member supporting structure block diagram concerning the 3rd example of this invention. The same sign is given to the part which is common in the above-mentioned example, and explanation is omitted.

[0043] This example is the optical member supporting structure which combined the 1st example and the 2nd example. In the optical member supporting structure of this example, the side face of a mirror 31 in which the optical axis inclined is supported in a hydraulic jack 3 and 6 grades, and the rear face of a mirror 31 was supported in a hydraulic jack 22 and 26 grades.

[0044] In addition, although each above-mentioned example described the case where it applied to the mirror of an optical member, it can replace with a mirror and can also apply to a lens.

[0045]

[Effect of the Invention] When exchanging an optical member for other vertical mold mirrors from which a dimension and weight differ according to the optical member supporting structure of this invention since the holding power of a jack is uniformly distributed by the weight of an optical member as explained above, it is not necessary to redo adjustment of the holding power in each retaining point, and exchange of an optical member becomes easy.

[0046] Moreover, when exchanging a horizontal-type optical member for other horizontal-type optical members, while it is not necessary to redo adjustment of the holding power in each retaining point and exchange of a horizontal-type optical member becomes easy according to the optical member supporting structure of a configuration of supporting the underside of a horizontal-type optical member with at least four jacks, the tilt of a horizontal-type optical member is kept level.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing 1 is the whole block diagram showing the optical member supporting structure concerning the 1st example of this invention.

[Drawing 2] Drawing 2 is the side elevation of the optical member supporting structure of drawing 1 .

[Drawing 3] Drawing 3 is the whole block diagram showing the optical member supporting structure concerning the 2nd example of this invention.

[Drawing 4] Drawing 4 is the side elevation of the optical member supporting structure of drawing 3 .

[Drawing 5] Drawing 5 is the whole block diagram showing the busy condition of the optical member supporting structure concerning the 3rd example of this invention.

[Drawing 6] Drawing 6 is drawing showing ideal allocation of the holding power of the supporting structure of a vertical mold mirror.

[Description of Notations]

1 Vertical Mold Mirror

2-7 Hydraulic jack

2a-7a Piston

2c-4c Piston narrow diameter portion

8 Reserve Tank

10 Vacuum Devices

11 Piston Assembly

12-17 Piping

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		6920－2Ｋ	Ｇ０２Ｂ　7/ 18	Ｂ
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審査請求　未請求　請求項の数３　ＦＤ　（全　６　頁）

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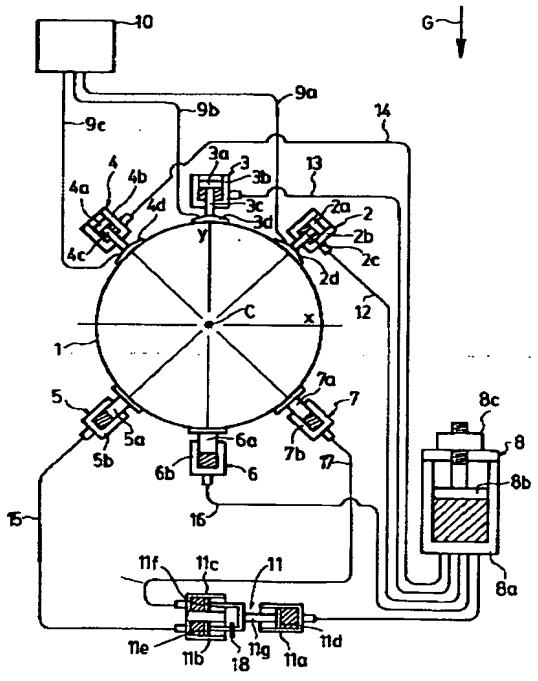
(54)【発明の名称】　光学部材保持装置

(57)【要約】

【目的】　保持力調整を不要にしてミラーの交換を容易する。

【構成】　縦型ミラー１の上側の油圧ジャッキ２～４と下側の油圧ジャッキ５～７とでは、ピストンの動作特性が逆であるので、下側の油圧ジャッキ５～７のピストン５ａ～７ａが下がれば、上側の油圧ジャッキ２～４のピストン２ａ～４ａが上がる。また各ピストン２ａ～７ａの径は保持点に応じてそれぞれ所定値に設定され、縦型ミラー１の重量により各油圧ジャッキ２～７の保持力が均等に分配され、歪を最小に抑えた状態で縦型ミラー１を保持することができる。



【特許請求の範囲】

【請求項１】　水平光軸の円板状の縦型光学部材の円周方向に沿って所定間隔おきに配置されて前記縦型光学部材の側面を支持する支持部材と該支持部材を移動可能に保持する保持部材とを備えた少なくとも４個のジャッキと、

前記支持部材と前記保持部材との間の空間に同圧力の流体を供給する圧力源とを備え、

前記４個のジャッキのうち、前記空間の圧力上昇に応じて前記支持部材が前記光学部材の中心に対して互いに反対方向へ動作する、前記縦型光学部材の上側を支持する２個のジャッキと、前記縦型光学部材の下側を支持する２個のジャッキとをそれぞれ対向配置し、

前記４個のジャッキの支持部材と保持部材の径を、前記縦型光学部材に対して前記各支持部材が及ぼす力の配分が所定の配分になるように設定し、

前記縦型光学部材の上側の２個のジャッキの支持部材に前記縦型光学部材を連結する連結手段を配設し、

前記縦型光学部材の下側又は上側を支持する２個のジャッキの前記支持部材の突出し量を同じにするＸ方向固定手段を設けたことを特徴とする光学部材保持装置。

【請求項２】　前記圧力源から供給される前記流体の量を調整するＹ方向調整手段を設けたことを特徴とする請求項１記載の光学部材保持装置。

【請求項３】　垂直光軸の円板状の横型光学部材の円周方向に沿って等間隔おきに配置され、前記横型光学部材の下面を支持する支持部材と該支持部材を移動可能に保持する保持部材とを備えた少なくとも４個のジャッキと、

前記支持部材と前記保持部材との間の空間に同圧力の流体を供給する圧力源とを備え、

前記４個のジャッキのうち前記横型光学部材の下面上で直交する２軸の一方の軸上に位置する２個のジャッキと前記圧力源とを接続する配管の途中に、両ジャッキの前記支持部材の突出し量を同じにする第１のチルト固定手段を設け、

他方の軸上に位置する２個のジャッキと前記圧力源とを接続する配管の途中に、両ジャッキの前記支持部材の突出し量を同じにする第２のチルト固定手段を設けたことを特徴とする光学部材保持装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は光学部材保持装置に関し、特にウエハ上に微細パターンを転写する半導体露光装置等の投影光学系のミラーの保持装置として好適な光学部材保持装置に関する。

【０００２】

【従来の技術】従来の光学部材保持装置は水平光軸の円板状の縦型ミラーを保持する複数の伸縮可能な調整具により構成され、各調整具は縦型ミラーの側面に所定間隔おきに配設される。

【０００３】図６は縦型ミラーの保持装置の保持力の理想的な配分を示す図である。図中矢印Ｇは重力方向を示す。Ｙ軸上の力をF_0とし、Ｙ軸からの角度をθとしたとき、保持力Ｆは

$$F = F_0 \cos\theta \quad （1）式$$

となる。

【０００４】図６は（１）式の理想的な重量配分をベクトル６２～６７で表している。

【０００５】従来、この配分にするため、各調整具を伸縮させて縦型ミラー１を押したり、引いたりして調整していた。

【０００６】

【発明が解決しようとする課題】ところが、縦型ミラーを別の縦型ミラーに交換する場合、交換の度に縦型ミラーの寸法や重量が変わるので、各保持点における保持力の調整をやり直す必要があり、縦型ミラーの交換は煩雑であった。また、縦型ミラーを同じ型の縦型ミラーに交換する場合にも、縦型ミラーの寸法や重量は微妙に変化するので、再調整の必要があった。

【０００７】更に、中には寸法が変わっただけで光学部材保持装置を作り直さなければならないこともあった。

【０００８】この発明はこのような事情に鑑みてなされたもので、その課題は保持力調整が不要で、ミラーの交換が容易な光学部材保持装置を提供することである。

【０００９】

【課題を解決するための手段】前述の課題を解決するため請求項１記載の発明の光学部材保持装置は、水平光軸の円板状の縦型光学部材の円周方向に沿って所定間隔おきに配置されて前記縦型光学部材の側面を支持する支持部材と該支持部材を移動可能に保持する保持部材とを備えた少なくとも４個のジャッキと、前記支持部材と前記保持部材との間の空間に同圧力の流体を供給する圧力源とを備え、前記４個のジャッキのうち、前記空間の圧力上昇に応じて前記支持部材が前記光学部材の中心に対して互いに反対方向へ動作する、前記縦型光学部材の上側を支持する２個のジャッキと、前記縦型光学部材の下側を支持する２個のジャッキとをそれぞれ対向配置し、前記４個のジャッキの支持部材と保持部材の径を、前記縦型光学部材に対して前記各支持部材が及ぼす力の配分が所定の配分になるように設定し、前記縦型光学部材の上側の２個のジャッキの支持部材に前記縦型光学部材を連結する連結手段を配設し、前記縦型光学部材の下側又は上側を支持する２個のジャッキの前記支持部材の突出し量を同じにするＸ方向固定手段を設けた。

【００１０】また、請求項２記載の発明の光学部材保持装置は、前記圧力源から供給される前記流体の量を調整するＹ方向調整手段を設けた。

【００１１】更に、請求項３記載の発明の光学部材保持装置は、垂直光軸の円板状の横型光学部材の円周方向に沿って等間隔おきに配置され、前記横型光学部材の下面を支持する支持部材と該支持部材を移動可能に保持する保持部材とを備えた少なくとも４個のジャッキと、前記支持部材と前記保持部材との間の空間に同圧力の流体を供給する圧力源とを備え、前記４個のジャッキのうち前記横型光学部材の下面上で直交する２軸の一方の軸上に位置する２個のジャッキと前記圧力源とを接続する配管の途中に、両ジャッキの前記支持部材の突出し量を同じにする第１のチルト固定手段を設け、他方の軸上に位置する２個のジャッキと前記圧力源とを接続する配管の途中に、両ジャッキの前記支持部材の突出し量を同じにする第２のチルト固定手段を設けた。

【００１２】

【作用】光学部材の上側のジャッキと下側のジャッキとでは、ピストンの動作特性が逆であるので、下側のジャッキのピストンが下がれば、上側のジャッキのピストン上がり、また各ピストンの径は保持点に応じてそれぞれ所定値に設定され、光学部材の重量により各ジャッキの保持力が均等に分配される。

【００１３】また、少なくとも４個のジャッキで横型光学部材の下面を支持し、４個のジャッキのうち横型光学部材の下面上で直交する２軸の一方の軸上に位置する２個のジャッキと圧力源とを接続する配管の途中にそれらのジャッキのピストン突出し量を同じにする第１のチルト固定手段を設け、他方の軸上に位置する２個のジャッキと圧力源とを接続する配管の途中にそれらのジャッキのピストン突出し量を同じにする第２のチルト固定手段を設けるようにすれば、横型光学部材の重量によりジャッキの保持力が均等に分配され、横型光学部材のチルトも水平に保たれる。

【００１４】

【実施例】以下この発明の実施例を図面に基づいて説明する。

【００１５】図１はこの発明の第１実施例に係る光学部材保持装置を示す全体構成図、図２は図１の光学部材保持装置の側面図である。水平光軸の円板状の縦型ミラー１の側面は６個の油圧ジャッキ２～７によって支持され、油圧ジャッキ２～７は縦型ミラー１の円周方向に沿って所定間隔おきに配置されている。油圧ジャッキ２～７は、半径方向以外に力がかからないように、図示しないフレームに図示しないユニバーサルジョイント等を用いて取り付けられている。

【００１６】油圧ジャッキ２～７はピストン２ａ～７ａとシリンダ２ｂ～７ｂとで構成されている。図中矢印Ｇは重力方向を示し、縦型ミラー１の上側に配置された油圧ジャッキ２～４のピストン２ａ～４ａの一部を構成するピストン小径部２ｃ～４ｃの先端には、縦型ミラー１の側面を吸着するための吸着盤２ｄ～４ｄが設けられている。吸着盤２ｄ～４ｄは配管９ａ～９ｃを介して真空装置１０に接続されている。真空装置１０が作動すると吸着盤２ｄ～４ｄが縦型ミラー１の側面に吸着し、油圧ジャッキ２～４と縦型光学ミラー１とが連結される。

【００１７】油圧ジャッキ２～７は配管１２～１７を介してリザーブタンク８に接続されている。リザーブタンク８は油圧ジャッキ２～７のシリンダ２ｂ～７ｂに同圧力のオイルを供給する。

【００１８】前記ピストン２ａ～７ａの径はそれぞれ所定値に設定されている。縦型ミラー１の上側に配置された油圧ジャッキ２～４では、ピストン３ａの径（この上側の場合、ピストン小径部の面積を除いた、圧力を受ける部分の面積を意味する。）がピストン２ａ，４ａの径より大きく、ピストン２ａ，４ａの径は互いに等しい。縦型ミラー１の下側に配置された油圧ジャッキ５～７では、ピストン６ａの径がピストン５ａ，７ａの径より大きく、ピストン５ａ，７ａの径は互いに等しい。

【００１９】また、上側、下側の油圧ジャッキの力を釣り合わせる為、ピストン３ａ，６ａの径は等しく、２ａ，４ａ，５ａ，７ａの径も等しい。

【００２０】ピストン２ａ～７ａの径を上記のように設定することにより、各保持点における保持力が前記（１）式の理想的な配分（縦型ミラー１の歪が最小になる配分）になるように、圧力を変えている。保持力は半径方向で縦型ミラー１のＹ軸（鉛直軸）上で最大値になり、Ｘ軸上でゼロになる。減少してゆく特性はＣＯＳ０～９０°になる。縦型ミラー１の上側に配置された油圧ジャッキ２～４は縦型ミラー１を引き上げるように作用し、縦型ミラー１の下側に配置された油圧ジャッキ５～７は縦型ミラー１を押し上げるように作用する。上側の油圧ジャッキ２～４の力の方向と下側の油圧ジャッキ５～７の力の方向とは逆であるが、大きさは同じである。この実施例では上側の油圧ジャッキ２～４と下側の油圧ジャッキ５～７とでは、ピストンの使用方向が逆であるので、下側の油圧ジャッキ５～７のピストン５ａ～７ａが下がれば、上側の油圧ジャッキ２～４のピストン２ａ～４ａが上がる。　前記リザーブタンク８はシリンダ８ａと、ピストン８ｂと、ピストン位置を調節する機構８ｃとを有し、ピストン位置を調節することにより、配管１２～１７内の総油量は変わり、ミラー中心を装置中心（各保持点を結んでできた多角形の中心）Ｃに合わせるときのＹ方向の調整を行うことができる。

【００２１】配管１２～１７のうち、配管１５，１７は途中で１本の配管になり、その分岐点にはＸ方向固定手段としてのピストン組品１１が配設されている。ピストン組品１１は、シリンダ１１ａと、シリンダ１１ｂ，１１ｃと、ピストン１１ｄ，１１ｅ，１１ｆと、ロッド１１ｇとで構成されている。シリンダ１１ａはリザーブタンク８に接続されている。シリンダ１１ｂは油圧ジャッキ５に接続され、シリンダ１１ｃは油圧ジャッキ７に接

続されている。

【００２２】ピストン１１ｄはシリンダ１１ａに収容され、ピストン１１ｅはシリンダ１１ｂに、ピストン１１ｆはシリンダ１１ｃにそれぞれ収容される。ロッド１１ｇの片側は二股に形成され、ピストン１１ｅ，１１ｆに連結され、ロッド１１ｇの片側にはピストン１１ｄが連結され、ピストン１１ｄに連動してピストン１１ｅ，１１ｆが摺動する。また、ロッド１１ｇには、油圧ジャッキ５のピストン５ａの突出し量と油圧ジャッキ７のピストン７ａの突出し量との差を調整するために、ピストン１１ｅの位置を調節する調節部材１８が取り付けられている。

【００２３】また、ピストン１１ｅ，１１ｆの径は等しく、両ピストン１１ｅ，１１ｆの受圧面積の和とピストン１１ｄの受圧面積とは等しいので、ピストン組品１１の入出力の圧力は変わらない。

【００２４】次に、この実施例の光学部材保持装置の動作を説明する。

【００２５】真空装置１０が作動すると、縦型ミラー１の上側に配置された油圧ジャッキ２～４の吸着盤２ｄ～４ｄが縦型ミラー１の側面に吸着し、油圧ジャッキ２～４と縦型ミラー１とが連結される。このとき縦型ミラー１の下側に配置された油圧ジャッキ５～７のピストン５ａ～７ａと縦型ミラー１の側面との間にはわずかなクリアランスが存在しているとする。

【００２６】油圧ジャッキ２～４と縦型ミラー１とが連結されると、油圧ジャッキ２～４のピストン２ａ～４ａは縦型ミラー１の重力を受けて次第に下降する。ピストン２ａ～４ａが下降すると、オイルはシリンダ２ｂ～４ｂから吐出し、リザーブタンク８を介して縦型ミラー１の下側に配置された油圧ジャッキ５～７へ供給される。オイルが供給されると、油圧ジャッキ５～７のシリンダ５ｂ～７ｂ内の油圧が高くなり、ピストン５ａ～７ａが上昇し（突き出し）、縦型ミラー１の側面に当接する。このようにしてピストン５ａ～７ａと縦型ミラー１とのクリアランスがゼロになったとき、油圧ジャッキ２～７が縦型ミラー１の重量を分かち合うことになり、荷重が釣り合ったとき縦型ミラー１のＹ方向位置が定まる。このときの各ピストン２ａ～７ａのＹ方向分力の和が縦型ミラー１の重量になる。

【００２７】また、ピストン２ａ～４ａが下降してリザーブタンク８へオイルが供給されたとき、オイルの一部はピストン組品１１のシリンダ１１ａ内に流入し、ピストン１１ｄが図１の左方向へ移動し、ピストン１１ｄに連動してピストン１１ｅ，１１ｆが同方向へ同じストローク量だけ移動する。前述のように油圧ジャッキ５，７のピストン５ａ，７ａの径とは等しいので、シリンダ５ｂ，７ｂへピストン組品１１から同圧のオイルが供給されたとき、ピストン５ａ，７ａのストローク量（突出し量）は同じになる。この結果、縦型ミラー１のＸ方向位置が拘束される。

【００２８】この実施例の光学部材保持装置によれば、縦型ミラー１の重量により油圧ジャッキ５～７の保持力が均等に分配されるので、縦型ミラー１を寸法や重量が異なる他の縦型ミラーに交換するとき、各保持点における保持力の調整をやり直す必要がなく、縦型ミラーの交換作業が容易になる。

【００２９】なお、この実施例の光学部材保持装置は重力を利用したシステムであるが、油圧配管１２～１７も重力の影響を受けるので、油圧の水頭差を補正する必要がある。ただ、水頭差による誤差は約１％（半径１５０㎜，厚さ５０㎜，比重３の縦型ミラーで、光学部材保持装置の水頭差が５００㎜，オイルの比重１のとき、縦型ミラーの上側と下側との保持力の差の縦型ミラーの重量の半分に対する割合）にすぎず、補正を省略してもよい。省略するかどうかはミラー精度によって判断すればよい。補正方法としてはピストン径の変更やレギュレータの使用等が考えられる。

【００３０】また、この実施例では、６個の油圧ジャッキ２～７を用いて縦型ミラーを６点保持するようにしたが、６個以上の偶数個の油圧ジャッキ２～７を用いるようにしてもよく、数が増えるほど保持力が分散され、縦型ミラー１に与える影響を小さくすることができる。

【００３１】更に、この実施例では、非圧縮性流体としてオイルを利用した場合について述べたが、これに代え、ミラー精度によっては空気等の圧縮性流体を用いるようにしてもよい。

【００３２】なお、この実施例では、ピストン組品１１を縦型ミラー１の下側に配置された油圧ジャッキ５，７の配管１５，１７の途中に配設した場合について述べたが、これに代え、縦型ミラー１の上側の油圧ジャッキ２，４の油圧配管１２，１４の途中に配設するようにしてもよい。

【００３３】また、この実施例の各油圧ジャッキ２～７の作動部に圧力メータ、レギュレータを追加して調整機能を高めるようにしてもよい。

【００３４】更に、この実施例ではピストン２ａ～７ａの径をそれぞれ所定値に設定した場合について述べたが、これに代え、レギュレータ（圧力調整器）を用いるようにすればピストン径を同じにすることができる。

【００３５】なお、この実施例では、連結手段としての吸着盤２ｄ～４ｄを縦型ミラー１の側面に吸着させたが、これに代え、油圧ジャッキ２～４のピストン小径部２ｃ～４ｃの先端を縦型ミラー１の側面に接着させるか、縦型ミラー１の側面に穴若しくは溝付きのボスを設け、フレーム側の部材と連結させるようにしてもよい。

【００３６】また、本実施例では油圧ジャッキを６個用いる構成としたが、図１のＹ方向に配置されたジャッキ３，６を除く４個でミラー１を保持する構成としても構わない。

【００３７】図３はこの発明の第２実施例に係る光学部材保持装置の全体構成図、図４は図３の光学部材保持装置の側面図である。

【００３８】前述の実施例では６個の油圧ジャッキ２～７を用いて縦型ミラー１の側面を６点保持する光学部材保持装置について述べたが、この実施例では垂直光軸の円板状の横型ミラーの保持装置について述べる。

【００３９】この実施例では、８個の油圧ジャッキ２２～２９が用いられ、各油圧ジャッキ２２～２９は横型ミラー２１の円周方向に沿って一定間隔おきに配置されている。各油圧ジャッキ２２～２９は横型ミラー２１の下面を支持している。また、油圧ジャッキ２２～２９は配管３２～３９を介してリザーブタンク４８に接続されている。

【００４０】横型ミラー２１の下面上で直交する２軸P_1，P_2の一方の軸P_1上に位置する２個の油圧ジャッキ２２，２６とリザーブタンク４８とを接続する配管３２，３６の途中に各ジャッキ２２，２６のピストン突出し量を同じにする第１のチルト固定手段としてのピストン組品４１を設け、他方の軸P_2上に位置する２個の油圧ジャッキ２４，２８とリザーブタンク４８とを接続する配管３４，３８の途中に各ジャッキ２４，２８のピストン突出し量を同じにする第２のチルト固定手段としてのピストン組品５１を設けた。ピストン組品４１，５１の構造は図１のピストン組品１１と同じであり説明を省略する。ピストン組品４１，５１により横型ミラー２１のチルトが拘束される。

【００４１】この実施例の光学部材保持装置によれば、横型ミラー２１の重量により油圧ジャッキ２２～２９の保持力が均等に分配されるので、横型ミラー２１を他の横型ミラーに交換するとき、各保持点における保持力の調整をやり直す必要がなく、横型ミラー２１の交換作業が容易になる。

【００４２】図５はこの発明の第３実施例に係る光学部材保持装置の全体構成図である。前述の実施例と共通する部分には同一の符号を付して説明を省略する。

【００４３】この実施例は第１実施例と第２実施例とを組み合わせた光学部材保持装置である。この実施例の光学部材保持装置では、光軸が傾いたミラー３１の側面を油圧ジャッキ３，６等で支持し、ミラー３１の裏面を油圧ジャッキ２２，２６等で支持するようにした。

【００４４】なお、前述の各実施例では、光学部材のミラーに適用した場合について述べたが、ミラーに代えてレンズに適用することもできる。

【００４５】

【発明の効果】以上説明したようにこの発明の光学部材保持装置によれば、光学部材の重量によりジャッキの保持力が均等に分配されるので、光学部材を寸法や重量が異なる他の縦型ミラーに交換するとき、各保持点における保持力の調整をやり直す必要がなく、光学部材の交換作業が容易になる。

【００４６】また、少なくとも４個のジャッキで横型光学部材の下面を支持する構成の光学部材保持装置によれば、横型光学部材を他の横型光学部材に交換するとき、各保持点における保持力の調整をやり直す必要がなく、横型光学部材の交換作業が容易になるとともに、横型光学部材のチルトは水平に保たれる。

【図面の簡単な説明】

【図１】図１はこの発明の第１実施例に係る光学部材保持装置を示す全体構成図である。

【図２】図２は図１の光学部材保持装置の側面図である。

【図３】図３はこの発明の第２実施例に係る光学部材保持装置を示す全体構成図である。

【図４】図４は図３の光学部材保持装置の側面図である。

【図５】図５はこの発明の第３実施例に係る光学部材保持装置の使用状態を示す全体構成図である。

【図６】図６は縦型ミラーの保持装置の保持力の理想的な配分を示す図である。

【符号の説明】

１　縦型ミラー

２～７　油圧ジャッキ

２ａ～７ａ　ピストン

２ｃ～４ｃ　ピストン小径部

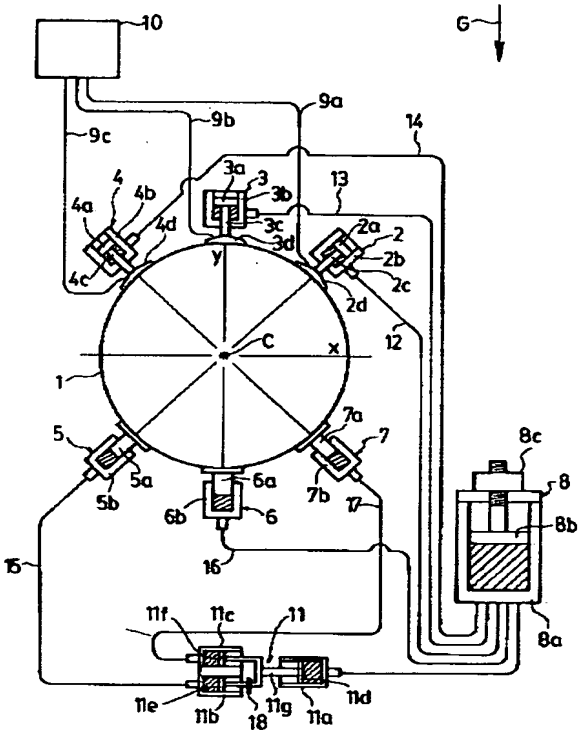
８　リザーブタンク

１０　真空装置

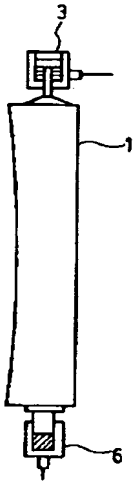
１１　ピストン組品

１２～１７　配管

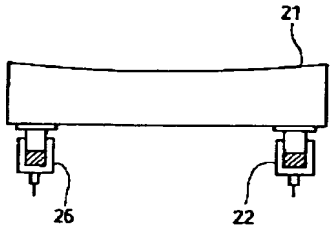
【図１】



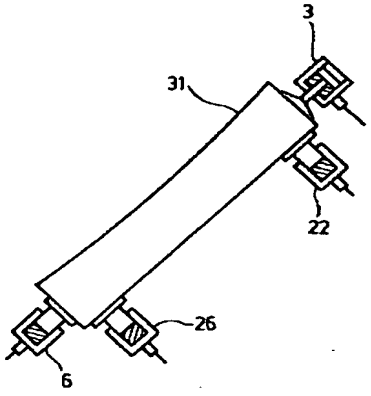
【図２】



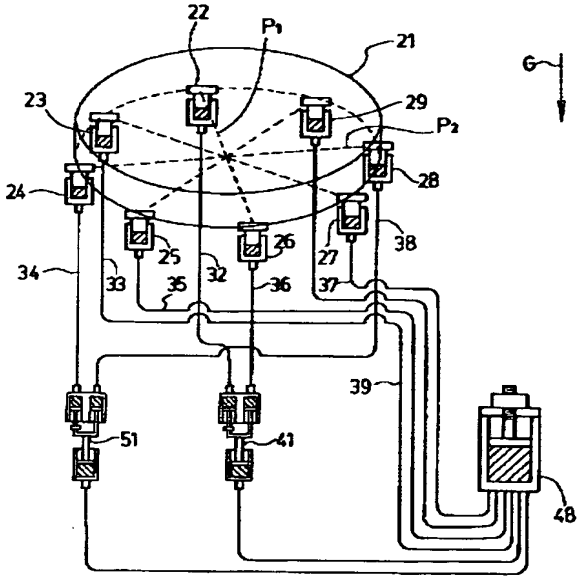
【図４】



【図５】



【図３】



【図６】